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RADIATION EFFECTS ON SILICON SOLAR CELLS

Fifth Monthly Progress Report Covering the Period
June 1 - 30, 1962

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This fifth monthly progress report on Contract No. NAS7-91, Radiation Effects on Silicon Solar Cells, covers the period June 1 - 30, 1962. During this period experiments utilizing galvanomagnetic measurements, carrier lifetime observations, and infrared absorption on irradiated silicon have continued.

Samples of phosphorus-doped floating-zone refined n-type silicon were irradiated with 38-Mev electrons. Initial resistivities of the samples varied between 50 and 0.1 ohm-cm. The carrier removal rate in this material was approximately a factor of 4 higher than that observed for similar irradiations of pulled silicon crystals. A temperature dependent measurement of the reciprocal Hall coefficient indicated that an energy level at approximately .36 ev was responsible for the carrier removal. These results seem to indicate that the rate of change of resistivity due to the E-centers introduced in floating-zone refined silicon is greater than that produced by the A-centers in pulled silicon. This point will be checked by further experiment and analysis.

Measurements of carrier lifetime in pulled silicon irradiated at room temperature have been performed. The modifications in the lifetime measuring experiments which were described during the last quarterly status report have on the whole been successful and a detailed experiment was performed on a sample with an initial doping of 10^{15} phosphorus donors/cm^3. The data from this experiment are now awaiting analysis. The analysis has been postponed pending completion of a semiautomatic data analysis system which will be ready for use within a few weeks. This system enables an operator to scan a film and automatically punch the coordinates of points along the oscilloscope trace on a standard Friden tape. These coordinates are then transcribed onto IBM punched cards using a Flexowriter. A computer program, which has previously been developed for analyzing some ionized gas experiments, can, with only minor modifications, be utilized to correct the observations for oscilloscope gains, relative accelerator intensities and add up the traces taken with plus and minus voltage applied to cancel out background noise. The resultant decay curve is then fit to an exponential decay by a least squares method and a quantity which measures the accuracy of this fit is also calculated. Other output quantities which are calculated include the intercept and the areas under each of the decay curves. Use of this system will save much time in both scanning the film and plotting the data and will eliminate the subjective nature of the usual lifetime procedure which involves plotting the data on semilog paper and fitting a straight line to them.

The sample on which the infrared absorption was previously measured before irradiation and after one irradiation has been re-irradiated to a flux approximately 5 times greater than the previous experiment. It has also been measured in the infrared spectrometer and the data are being analyzed.

Plans for future work include a continuation of the analysis of the results of galvanomagnetic experiments to determine the introduction rates of the pertinent defects as well as the energy level positions. The lifetime experiments will be continued and analyzed in terms of cross sections for electron and hole capture. The infrared experiments will be continued to determine at what defect concentration significant infrared absorption can be detected and then to plan appropriate correlation experiments with the galvanomagnetic measurements. Electron spin resonance experiments will also commence in the near future since the cryostat for performing the ESR measurements is now being assembled.

The following personnel have participated in this research program during this month: D. M. J. Compton, S. K. Boehm, R. Denson, H. Güereña, J. W. Harrity, H. Horiye, S. Kurnick, V. A. J. van Lint, E. G. Wikner, and M. E. Wyatt.